A Robust Biofilm-Biomat Reactor for Conversion of Mission-Relevant Feedstocks to Products, Phase I

Completed Technology Project (2018 - 2019)

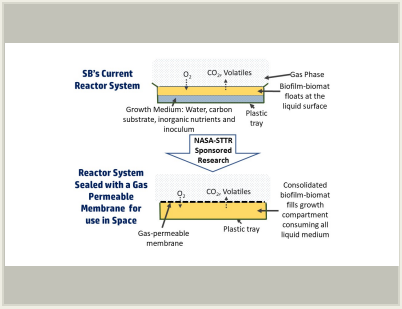
Project Introduction

Sustainable Bioproducts (SB) proposes to develop an encapsulated biofilm-biomat reactor that will efficiently convert mission relevant feedstocks to usable products under zero gravity conditions. The bioreactor will be based on SB's proprietary fermentation platform for converting a wide variety of waste streams into a multitude of usable products. SB's bioreactor platform is simple, does not require energy during fermentation (other than temperature control), requires little water, and produces a very dense, easily harvested, consolidated/textured biomats with little to no waste. The biofilm-biomat fermentation technology enables growth on extreme media such as human waste (urine/feces) and produces a highly consolidated and textured biomass without the requirement of a separation or concentration step. Relatively high biomass production rates (0.55 g/L/h dry biomass) and high culture densities (100-180 g/L) are achieved without the need for active aeration or agitation. Scale-up of the system vertically or horizontally is simple and does not result in decreased productivity. The NASA sponsored research will optimize conversion of mission relevant feedstocks (human waste, food waste, plant materials) by adjusting reactor design and growth conditions. The biofilm-biomats produced in the optimized reactor system will be highly textured, 0.2 to 2.5 cm thick with a dry matter content of 10-18% and can be readily used for mission critical needs such as meat alternatives, other appetizing foods, fuels and building materials.

Anticipated Benefits

Closing life-support loops for NASA space missions: 1) Robust low maintenance bioreactors that do not require active aeration or agitation for rapid growth of filamentous microorganisms under zero gravity, 2) A biofilm-based reactor technology that enables growth on a wide variety of harsh feedstocks, 3) Bioreactors that producing dense, consolidated and easily harvested biomass, 4) An efficient production system that generates minimal waste residues, 5) A bioreactor system that easily scales

SB envisions advancing their current reactor technology to a hermetic reactor system for use in a wide variety of situations where protein-rich food is needed quickly, but access to food, and the resources to quickly produce food are limited. These situations include civilian needs during catastrophes such as earthquakes and floods, third world nations with urgent food needs, and food for support of military operations. Interest from governmental agencies such as USDA, FEM and DOD is expected.



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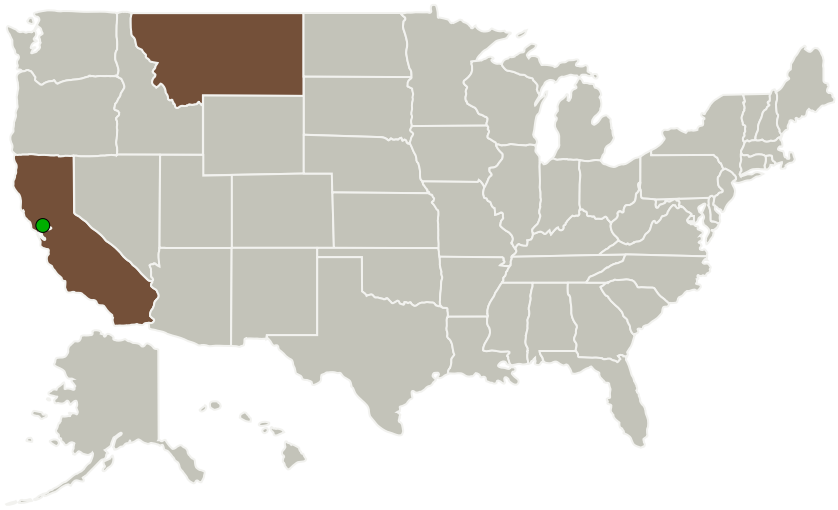
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Sustainable Bioproducts, LLC	Lead Organization	Industry	Bozeman, Montana
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
Montana State University - Bozeman, Center for Biofilm Engineering	Supporting Organization	Academia	Bozeman, Montana

Primary U.S. Work Locations	
California	Montana

Project Transitions

July 2018: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Sustainable Bioproducts, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

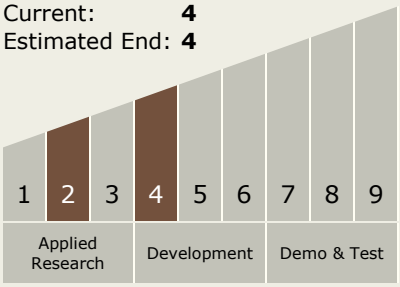
Carlos Torrez

Principal Investigator:

Rich Macur

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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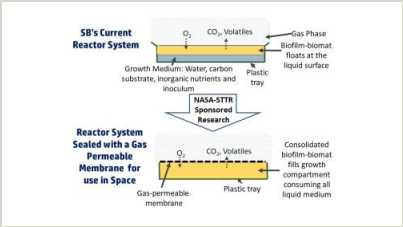
Completed Technology Project (2018 - 2019)

August 2019: Closed out

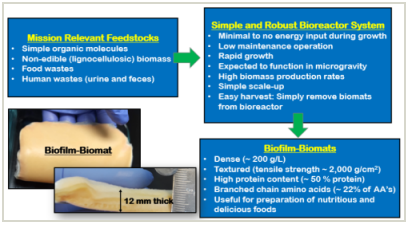
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141197)*

Images



Briefing Chart Image
A Robust Biofilm-Biomat Reactor for Conversion of Mission-Relevant Feedstocks to Products, Phase I *(https://techport.nasa.gov/image/130738)*



Final Summary Chart Image
A Robust Biofilm-Biomat Reactor for Conversion of Mission-Relevant Feedstocks to Products, Phase I *(https://techport.nasa.gov/image/129451)*

Links

Business Insider Story *(https://www.businessinsider.com/startup-protein-yellowstone-volcanic-hot-springs-sustainable-bioproducts-2019-1)*

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.3 Human Health and Performance
    - TX06.3.5 Food Production, Processing, and Preservation

Target Destinations

Earth, The Moon, Mars